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HYBRIDIZED PHOTOVOLTAIC LIQUID CRYSTAL CELLS AND LIGHT VALVES (PREPRINT)

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**Hardened Materials Branch
Survivability and Sensor Materials Division**

JANUARY 2006

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Hybridized Photovoltaic Liquid Crystal Cells and Light Valves



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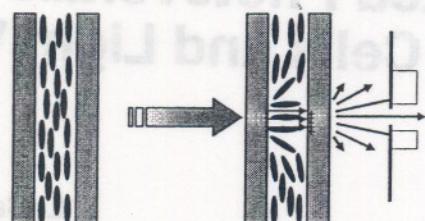
Outline



- Motivation
- Nonholographic Hybrid PV Cells
- Nonholographic Hybrid PV Light Valves
- Conclusions



Motivation



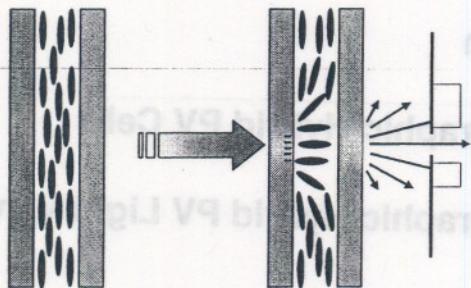
To develop a self-activated LC cell
using the photovoltaic effect from
photorefractive substrates



Nonholographic Hybrid PV Cells One Photorefractive Substrate



Field from one $\text{LiNbO}_3:\text{Fe}$ substrate
activates LC



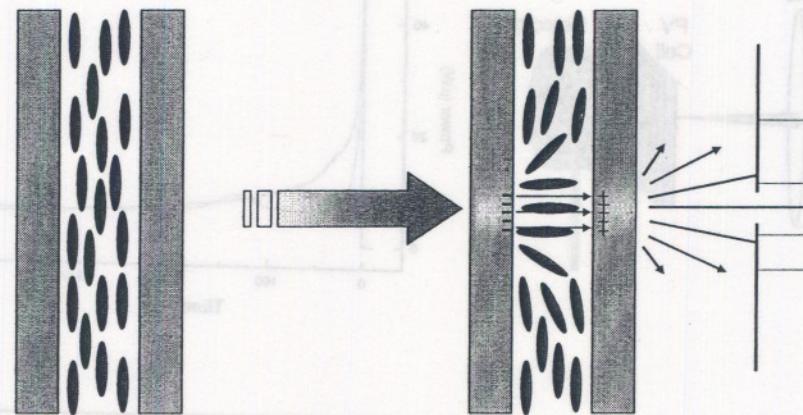
Very sensitive to focal position



Nonholographic Hybrid PV Cells Two Photorefractive Substrates



Field between two $\text{LiNbO}_3:\text{Fe}$ substrates
activates LC



Nonholographic Hybrid PV Cells Two Photorefractive Substrates

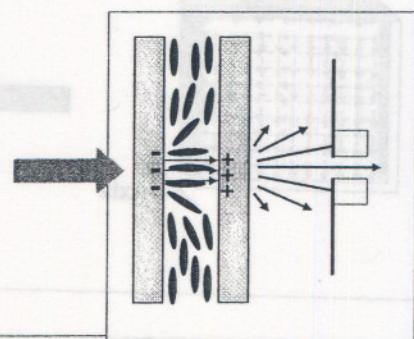
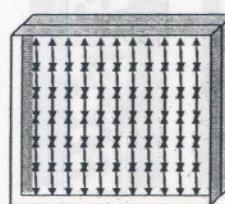


Substrates

0.05% $\text{LiNbO}_3:\text{Fe}$

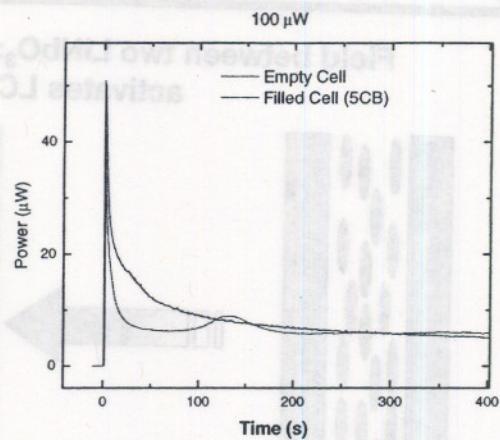
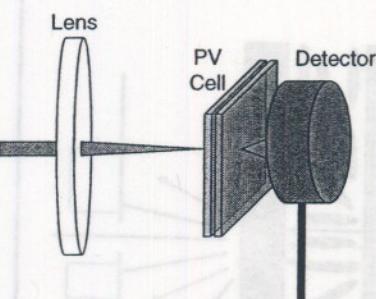
25 x 25 x 1 mm

$\alpha_{532} \approx 1.53 \text{ cm}^{-1}$





Nonholographic Hybrid PV Cells Two Photorefractive Substrates



Nonholographic Hybrid PV Light Valves Twisted Nematics

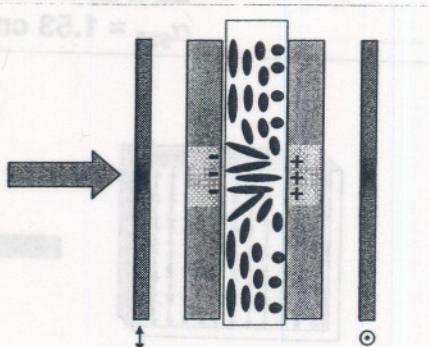
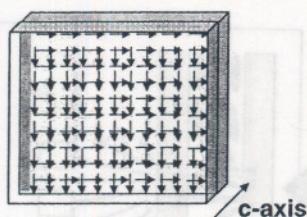


Substrates

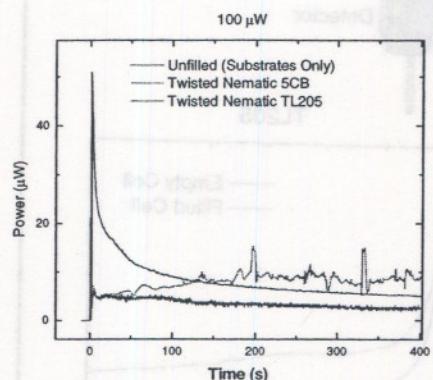
0.05% LiNbO₃:Fe

25 x 25 x 1 mm

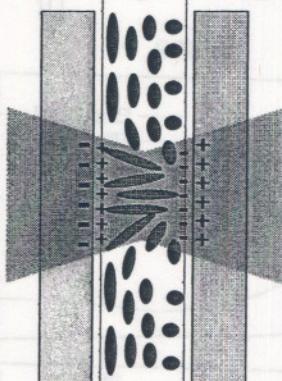
$\alpha_{532} \approx 1.53 \text{ cm}^{-1}$



Nonholographic Hybrid PV Light Valves Twisted Nematics

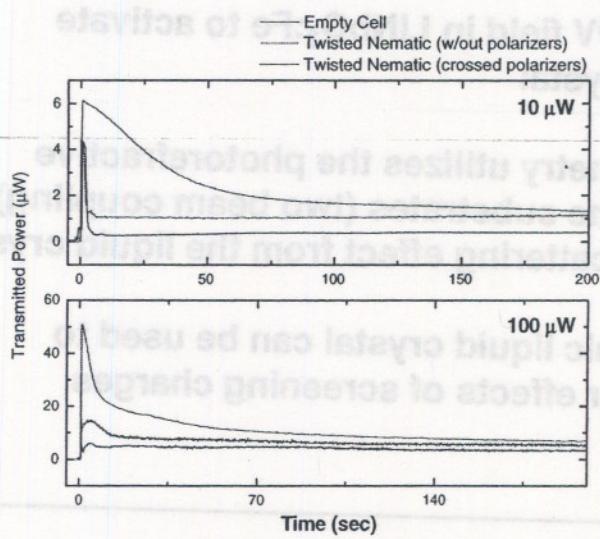


Screening Charges



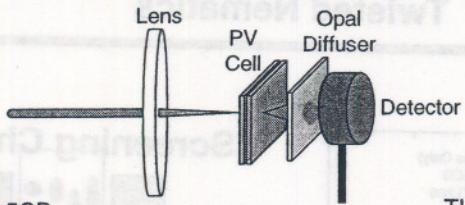
Less ionic LC (TL205) reduces buildup of screening charges, allowing DOD to increase

Nonholographic Hybrid PV Light Valves Twisted Nematics



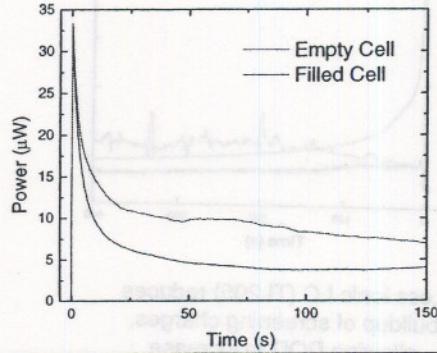
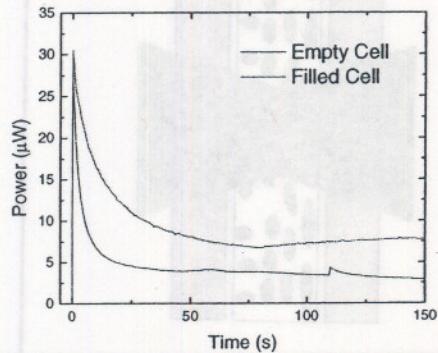


Role of the Liquid Crystal



5CB

TL205



Conclusions



- Can use PV field in $\text{LiNbO}_3:\text{Fe}$ to activate a liquid crystal
- This geometry utilizes the photorefractive effect in the substrates (two beam coupling) and the scattering effect from the liquid crystal
- A less ionic liquid crystal can be used to correct for effects of screening charges